Kept out

Fencing may be blocking some mass migrations. **Nigel Williams** reports.

Fencing in wildlife from human intrusion is becoming increasingly attractive in some regions (see page R465) but there are also worries that the effects of these fences and other human activity are having a major impact on the movement of the world's most spectacular migrating species.

All the world's large-scale terrestrial migrations have been severely reduced and a quarter of the migrating species are suspected to no longer migrate at all because of human changes to the landscape, according to new research.

"Conservation science has done a poor job in understanding how migrations work, and as a result many migrations have gone extinct," says Grant Harris of the Center for Biodiversity and Conservation at the American Museum of Natural History, reporting in *Endangered Species Research*. "Fencing, for example, blocks migratory routes and reduces migrant's access to forage and water. Migrations can then stop or be shortened, and animals plummet."

Migrations of large-bodied herbivores occur when animals search for higher quality or more abundant food. Ecologically, there are two primary drivers of food availability. In temperate regions of the world, higher-quality food shifts predictably as the seasons change, and animals respond by moving along well-established routes. For savannah ecosystems, rain and fire allow higher-quality food to grow. This is a less predictable change that animals must track across expansive landscapes.

Human activity now prevents large groups of ungulates from following their food. Fencing, farming, and water restrictions have changed the landscape and over-harvesting of the animals themselves has played a role in the reduction in number of migrants, the researchers report.

To assess the impact of human activity on migrations throughout the world, Harris and his colleagues gathered information on all 24 species of large ungulates known for mass migrations. Animals included in the study include Arctic caribou, North American bison and elk and African zebra and wildebeests.

The fewest number of mass-migrating species live in the Americas, but this is the location where most data exist. Evaluating the human impact on migratory species in Africa and Eurasia is hampered by a lack of data. In Africa, where most of the large-scale migrations remain, three species have no scientific publications on their status, and in Eurasia, half of the six remaining migratory species are very poorly documented, the researchers say.

All 24 species in the current study lost migration routes and were reduced in number of individuals. In north America, bison are still considered migratory, but their range is now restricted from the Great Plains to two small sites in Yellowstone and Alberta. Similar changes are found in other continents when human activity limits the ability of species to move to new patches of food. The study found even more drastic declines for six species in particular. The springbok, black wildebeest, blesbok, quagga of southern Africa, the kulan of central Asia, and scimitar-horned oryx of northern Africa either no longer migrate or are impossible to evaluate as migratory animals.

"If we are going to conserve migrations and species, we need to identify what needs to be done: where migrations remain, how far animals move, their habitat needs and location, threats, and the knowledge gaps needed to be filled," says co-author Joel Berger of the Wildlife Conservation Society and the University of Montana. "For some of these species, such as the wildebeest and eland in Botswana, threats were identified decades ago. We as a society have made little progress at figuring out how to save migrations."

"A large part of this is an awareness issue. People don't realize what we have and are losing," says Harris. We lose migrations and become biologically insensitive with farms and fences, "even though there is no reason why humanity cannot technically and socially advance while maintaining natural phenomena. A balance can be struck — we just need to strike it," he says.

Cheek by jowl

Biodiversity and other benefits can be met even in highly managed human landscapes. **Nigel Williams** reports.

One topic of increasing interest to conservationists is to assess the human value of ecosystems, from the provision of food and water to recreation, carbon storage and supporting biodiversity, to better understand their importance. But biodiversity and other ecosystem services are increasingly threatened by human activities. The hope among conservation biologists and policy makers is that future conservation strategies can counter this and deliver not only biodiversity, but also other ecosystem services.

Little is known about the performance of conservation strategies aside from large, north American-style 'wilderness' areas in delivering ecosystem services other than biodiversity. While such areas are ideal for providing global benefits such as carbon sequestration, the primary benefits for many services only apply at a much smaller spatial scale. This is a problem as most of the world's population do not live in or near large wilderness reserves. Parts of the eastern seaboard of the US, southeast Asia, western Europe, the Atlantic forests of Brazil and large parts of India are remote from wilderness areas.

"Only a few case studies have shown that areas set aside to conserve biodiversity also provide additional ecosystem services."

A new study by Felix Eigenbrod at the University of Sheffield, and colleagues at the University of York reporting in the *Proceedings of the Royal Society series B* (published online) has looked at small protected areas in England to see what ecosystem benefits such areas can provide, such as carbon storage, biodiversity and recreational use.

"The hope among conservation biologists and policy makers alike is that existing and future conservation strategies can deliver not only

Productive: A farming landscape like this in Derbyshire, central England, can deliver biodiversity and ecosystem benefits through the creation of small protected areas. (Photo: Lower Hurst Farm www.lowerhurstfarm.co.uk)

biodiversity but other ecosystem services.

Only a few case studies have shown that areas set aside to conserve biodiversity also provide additional ecosystem services, the researchers say.

The new study compares the delivery of biodiversity and three other ecosystem services — carbon storage, agricultural production and rural recreation — by three conservation strategies in England — protected areas, restrictive zoning and incentive payments to landowners. Restrictive zoning involves the use of planning legislation to restrict human development.

Investment in these strategies is substantial: the European Union spends approximately 3.7 billion euros per year on various agro-environment schemes and the US spent $1.8 billion in 2007.

England represents a good test of the effectiveness of different types of conservation strategies in delivering ecosystem services because protected areas, restrictive zoning and incentive payment schemes are all well developed covering more than 35 per cent of the land area, the researchers say.

The researchers looked at whether the ecosystem services provided by a conservation area were more or less than would be expected for that area.

The researchers say that small protected areas and protected landscapes deliver high carbon storage and biodiversity, while existing incentive payments offer little advantage over other parts of England in terms of carbon storage, biodiversity and agricultural production.

They found that protected areas had 3.3 times as much biodiversity as would be expected for their area. Carbon storage was also 1.8 times the expected value, as many such areas are in peatland and wetland sites.

The findings have wide-ranging policy implications because they provide the first illustration of how well conservation strategies in human dominated landscapes represent biodiversity and three other key ecosystem services, the authors write. But "our results indicate that achieving both high agricultural production and biodiversity is difficult within a single land management system," the authors say.

Our findings raise three key points with global implications, the researchers say. Past investments in conservation within human-dominated landscapes can, like those made in wilderness areas, provide both ecosystem services and biodiversity benefits, they believe.

"Relying on a portfolio of contrasting conservation strategies offers greater protection to biodiversity and other ecosystem services than relying on any one approach."

"But ultimately there are limits to the multifunctionality of landscapes with some trade-offs being inevitable and some services — recreation — falling through the policy cracks."